Design Guidelines for Surface Mount and Fine Pitch Technology

second edition

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Library of Congress Cataloging-in-Publication Data

Solberg, Vern.
Design guidelines for surface mount and fine-pitch technology / by Vern Solberg. — 2nd ed.
p. cm.
Includes index.
ISBN 0-07-059577-1
1. Printed circuits—Design and construction. 2. Surface mount technology. 3. Fine pitch technology. I. Title.
TK7868.P7.S637 1996 95-17264
621.3815'31—dc 20 CIP

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Solders for component attachment

Solder, an alloy made principally of tin and lead, provides reliable electrical connections and mechanically strong joints. Other metals such as antimony, silver, cadmium, indium, and bismuth are alloyed with tin and lead to control certain physical and mechanical properties of the alloy, e.g., melting range, tensile and shear, and even corrosion resistance.

Tin-lead or "soft" solder alloys are the most widely used in electronic applications, because their low melting temperatures make them ideal for rapid joining of most metals by conventional heating methods. Take care in specifying the proper alloy for each soldering method because each alloy has unique properties. When referring to tin-lead alloys, tin is customarily listed first. For example, 60/40 refers to 60 percent tin, 40 percent lead, by weight.

General-purpose solders include 40/60 and 50/50, which are typically used for plumbing and sheet-metal as well as for high-temperature electrical applications. Where minimum heat must be used during formation of the solder joint, as in surface mount assemblies (with heat-sensitive components and materials), higher tin-content alloys are required, such as 60/40 or 63/37.

Alloys of tin-lead with a small percentage of silver (63/35/2) are used to reduce the leaching of silver from silver alloy end termination of some passive components. These types of alloys are also ideal for soldering to thick-film silver alloy coatings on ceramic hybrid circuits. Bismuth-containing solders, which are frequently used as fusible alloys, can be used in applications where the soldering temperature must be below 183°C (38°F). Indium alloys, also with low-temperature melting ranges, are very ductile and are therefore suitable for joining metals with greatly different coefficients of thermal expansion.

Using solder pastes with SMT

Solder pastes are homogeneous mixtures of a paste-flux and fine-powder solder alloy. The physical and chemical characteristics of the material can be matched precisely to the solder joint requirements, e.g., the method of placement used and required definition, in-process conditions, solder-reflow method used, and cleaning requirements. Because all the ingredients required to successfully place and solder the components are contained in the paste, it is an ideal material for automated assembly of both simple

or complex mechanical, electrical, and electronic systems. With refined process development and controlled assembly procedures, reliable solder joints can be repetitively produced.

For the more difficult assembly applications, solder paste might provide the only practical method of solder attachment. Electronic grade solder pastes are manufactured to meet the critical requirements of electronic component assembly. The composition of the pastes can vary with individual requirements. A wide variety of compositions can be specified from suppliers, which comply with recognized standards, like those of the ASTM (American Society for Testing and Materials). Several solder attachment alloys are available for device attachment (see Table 10-1); each one has a unique melting point and can furnish the physical characteristic needed for the specific product or application.

■ Table 10-1 Solder alloy for device attachment.

High temp. alloy	**Melting temp. C**
96.5Sn/3.5Ag	221–226
95Sn/5Pb	222–227
96Sn/4Ag	238–243
95Sn/3.5Ag/1.5In	218–223
Standard alloy	**Melting temp. C**
63Sn/37Pb	185–190
62Sn/36Pb/2Ag	179–186
62Sn/36Pb/2In	179–185

In addition to selecting specific alloy compositions, the engineer must consider flux type required for the process. Both organic and inorganic fluxes are available and cannot be mixed in the various assembly processes. Organic systems might be preferred for ease of water cleaning and are generally environmentally acceptable. Organic solder-flux residues are very corrosive and must be removed from the board surface after reflow.

An example of a no-clean flux is the RMA. Mixed into the solder, it provides a paste-like material consisting of the following primary components:

- ☐ Solvent or vehicle.
- ☐ Rosin/resin or organic.
- ☐ Activator.
- ☐ Viscosity-control additives.